

REMARKS

Claims 29-41 are currently pending in the present application.

Claims 29, 38 and 39 have been. Claim 39 has been amended to correct the inadvertent error noted by the Examiner in the final Office Action. Support for the amendment to claim 39 can be found in the Specification and the original claims. Claims 29 and 38 have been amended to replace the phrase "having no grain boundaries" with the phrase --having an absence or large angle boundaries.-- Support for the amendments to claims 29 and 38 made herein can be found in the Specification, for example, at page 7, lines 1-7. The amendments made herein introduce no new matter. Additionally, a complete listing of all claims ever presented is set forth herein in accordance with 37 C.F.R. §1.121(c)(1). Entry of the amendments made herein is respectfully requested.

Claim Objection:

In the final Office Action, the Examiner objected to claim 39 due to the inadvertent use of the term "single crystal" where "amorphous" was clearly intended. Applicants have amended claim 39 to correct this inadvertent error. Removal of the objection is respectfully requested.

Rejection Under 35 U.S.C. §112, 1st Paragraph:

In the final Office Action, the Examiner rejected claims 29-33, 38 and 40 under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. While not necessarily agreeing with the Examiner that the phrase "having no grain boundaries" lacks adequate written description with respect to a tantalum film having a single crystal microstructure, in an effort to expedite prosecution, Applicants have amended claims 29 and 38 to replace the allegedly unsupported phrase with the substantively similar and explicitly recited phrase "having an absence of large angle boundaries." Reconsideration and withdrawal of the rejection under 35 U.S.C. §112, first paragraph, are respectfully requested.

Prior Art Rejections:

In the final Office Action, the Examiner advances four separate prior art rejections:

(i) the Examiner rejects claims 34-37, 39 and 41 under 35 U.S.C. §102(b), as anticipated by, or in the alternative, under 35 U.S.C. §103(a), as obvious over U.S. Patent No. 6,057,237 of Ding, *et al.* (“Ding”).

(ii) the Examiner also rejects claim 38 under 35 U.S.C. §103(a), as being obvious over the Stavrev article entitled, “Behavior of thin Ta-based Films in the Copper/Barrier/Si System” J. VAC. SCI. TECHNOL. A 17(3), May/June 1999 (“Stavrev”), in view of U.S. Patent No. 4,372,989 of Menzel, *et al.* (“Menzel”).

(iii) the Examiner rejects claim 40 as being obvious over Stavrev, Menzel and U.S. Patent No. 6,531,780 of Woo, *et al.*

(iv) the Examiner rejects claims 29-33 under 35 U.S.C. §102(b) as anticipated by, or in the alternative, under 35 U.S.C. §103(a), as obvious over the Marcus article entitled “Electrical and Structural Properties of Epitaxial bcc Tantalum Films” (“Marcus”), in view of Menzel.

Applicants respectfully traverse each of the Examiner’s rejections and the arguments and contentions set forth in support thereof for at least the following reasons.

With respect to Ding, Applicants respectfully submit that Ding does NOT teach or even suggest a tantalum film having the claimed amorphous microstructure. Ding refers to a “dense amorphous barrier layer” comprised of alternating tantalum and tantalum nitride depositions. However, at column 2, lines 60-62, Ding clearly states, “[a]s the layering is repeated, the composite becomes still more amorphous and dense, and very little crystallinity is to be seen.” Applicants respectfully submit that “more amorphous” and “little crystallinity” are not the amorphous microstructure presently claimed. The phase change between amorphous and

crystalline phases is a first-order phase transformation with atomically sharp interfaces. The material can exist either in crystalline or amorphous state. "Less crystalline" is still crystalline, NOT amorphous. The composite Ta/TaN layers described in Ding are crystalline. This is even clearer when one considers column 2, lines 54-62 and Figure 3 of Ding. The presence of (002) diffraction peak shows the material to be crystalline not amorphous. Applicants respectfully submit that Ding fails to teach or suggest tantalum films with the claimed amorphous microstructure. Moreover, the presently claimed diffraction peak attributes of the invention are not inherent in the teachings of Ding as the material disclosed therein is a crystalline composite of Ta and TaN. Reconsideration and withdrawal of the rejection based on Ding are respectfully requested.

With respect to Stavrev, Applicants respectfully note that Stavrev describes "amorphous-like" films of tantalum and additional elements which are "stuffed" into grain boundaries. (See, Stavrev, p. 994 left-hand column, bridging p. 994 right-hand column). Thus, by control of various conditions, Stavrev discloses producing amorphous-like, tantalum-containing films wherein existing grain boundaries are "stuffed" with O, N and/or C. More explicitly, in Table 1 at p. 995 of Stavrev, the nature of the films is described. Even the bottom three films (fcc TaN, Ta(O) and Ta(N,O)) have grain boundaries (free short circuit paths) despite being "stuffed" with nitrogen or oxygen. Stavrev does not describe amorphous films. Menzel does not remedy the deficiencies of Stavrev. Menzel describes site-specific crystallization of an already deposited film of tantalum. Menzel is directed to preparing pseudo-"metallizations" or conductive paths in a film. Menzel does NOT describe deposition of a tantalum film having a single crystal microstructure. Moreover, one of ordinary skill in the art would have no motivation to employ the specific "patterning" laser approach of Menzel to prepare a single crystal *film* of tantalum. Reconsideration and withdrawal of the rejection based on Stavrev and Menzel are respectfully requested.

With respect to the rejection based on Stavrev, Menzel and Woo, Applicants respectfully submit that Woo does not remedy the deficiencies of the Stavrev/Menzel combination. Woo is merely cited as support for the use of TaN and/or TiN as adhesion layers. This does not remedy the above-noted deficiency of the Stavrev/Menzel combination.

With respect to the Examiner's rejection of claims 29-33 as being obvious over Marcus and Menzel, Applicants respectfully submit that this rejection is entirely without merit. Marcus is directed to deposition of a tantalum film *on cleaved magnesium oxide*. Marcus does not teach, or even suggest *the claimed tantalum films disposed on a silicon substrate*, nor does Marcus provide guidance as to deposition thereon. Marcus clearly fails to anticipate the claimed invention, and further fails to satisfy the criteria necessary to establish *prima facie* obviousness. Marcus does not suggest the claimed invention, nor does the reference motivate one of ordinary skill in the art to modify it as would be needed to arrive at the claimed invention. As discussed above, Menzel is NOT directed to a single crystal tantalum *film*. Rather Menzel teaches a site specific, laser-modification of a deposited tantalum material to make conductive *pathways* of large crystalline tantalum phase. Withdrawal of the rejection on the basis of the Marcus reference, in combination with Menzel is respectfully requested.

None of the cited references teaches, let alone suggests, the claimed tantalum thin films with the recited microstructure characteristics. There is nothing in any of the cited references to motivate one of ordinary skill in the art to modify their teachings in order to arrive at Applicants' claimed invention. Furthermore, one of ordinary skill in the art would have no reasonable expectation of successfully preparing such tantalum films based on the teachings of the references.

Accordingly, Applicants submit that none of the cited references anticipates the claimed invention or satisfies the criteria necessary to establish *prima facie* obviousness as to the claimed invention.

Conclusion:

Applicants respectfully submit that all pending claims patentably distinguish over the prior art of record. Reconsideration, withdrawal of the rejections and a Notice of Allowance are respectfully requested.

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Respectfully submitted,

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